CHAPTER 5

OFFSHORE PETROLEUM DISCHARGE SYSTEM

Section I. OPDS Tankers

RESPONSIBILITIES

The Offshore Petroleum Discharge System was designed by and for the U.S. Navy, for use with the Army, and Marine Corps, Inland Petroleum Distribution System (IPDS), component parts of the Southwest Asia Petroleum Distribution Operational Project (SWAPDOP). The OPDS is stored on board a selected RRF tanker. It is transported to a theater of operations by the tanker. The U.S. Navy is responsible for installing the OPDS and ship-to-shore pipeline to the high-water mark. The OPDS provides 1.2 million gallons per 20-hour day of refined petroleum to the beach, from a tanker moored four miles offshore. The petroleum products are delivered from the offshore tanker to forces onshore where ports or terminal facilities are damaged, inadequate, or nonexistent. Each tanker is manned by a civilian merchant crew. The crew is train to operate, deploy, and recover the of the OPDS. Military personnel plan, direct, and control all the OPDS operations. The OPDS tanker must be able to begin pumping fuel within 48 hours of arrival. Where required, a permanent SPM will be operating by the seventh day after the tanker arrives in the objective area. The OPDS will also provide fuel for aircraft operating from field sites in the objective area. Table 5-1 gives the current commercial (OPDS) special tankers in the MSC inventory and their statistics. Table 5-2 shows the maximum working conditions for the OPDS.

Table 5-1. OPDS tanker statistics

TANKERS	LENGTH (feet)	BEAM (feet)	DRAFT (feet)	LONG TONS	FUEL CAPACITY (BBL)
S.S. Potomac	620	84	34	27,467	168,000
S.S. American Osprey	661	90	36	34,723	235,000
S.S. Chesapeake	736	102	40	50,023	255,000
S.S. Petersburg	736	102	40	50,063	225,000
S.S. Mount Washington	736	102	40	49,471	269,000

Table 5-2. Maximum conditions for the OPDS

OPERATIONS	CURRENT (knot)	WIND (knot)	WAVES (feet/height)
Installation	1	9-12	3
SALM	4	27-40	12
Maximum	4	48-55	22-35

OPDS TANKER SITE SURVEY

Prior to positioning the OPDS tanker, a site survey must be conducted. The general requirements for the tanker site are:

- Water depth at least 15 feet more than full load draft of tanker to permit launching the SALM.
- No obstructions in the area that would endanger the tanker during mooring maneuvers.
- The four-point mooring site to be not more than 24,000 feet from the BTU site.
- The tanker mooring site to be checked is a generally rectangular area of 2000 by 3000 feet, the corners of which will be occupied by the tanker's anchors.

RESUPPLY OF THE OPDS TANKER

There may be a need for the OPDS tanker to dock in a specific location longer than expected due to the amount of fuel supplies needed at that undeveloped theater of operation. Depending on the water depth, prevailing currents, and the judgment of the tanker's commander, resupply of the OPDS tanker can be resupplied in one of three ways:

- A resupply follow-on tanker may moor to the OPDS tanker at the OPDS SPM.
- The tanker may leave its mooring and conduct an underway lightering transfer of fuel from the follow-on tanker at an appropriate location.
- The OPDS tanker can leave the OPDS SPM for another loading port.

OPDS SYSTEM DESCRIPTION

The OPDS was designed to be installed and carried to the operating area on a medium-sized tanker. The tanker will be manned by a civilian merchant crew. The crew will be trained to operate, deploy, retrieve the OPDS. Other trained OPDS personnel may direct or assist in the tanker operations. Army or Navy personnel are trained install the components as they are deployed from the tanker. The OPDS consists of five principal subsystems. They are listed below:

- Commercial tanker with conduit (hoses) handling equipment.
- Conduit system of four nautical miles of flexible, elastomeric, steel reinforced, float/sink conduit on eight large storage reels.
- SALM.
- Converted SLWTs.
- BTUs.

Section II. Major Components (OPDS) Tanker

SINGLE ANCHOR LEG MOORING

The SALM is a large, steel, compartmented barge (Figure 5-1, page 5-3). It can be carried to the deployment site on the tanker skid beams. The SALM can be towed if needed. Like its commercial counterparts, it provides a SPM for the OPDS tanker that permits the tanker to weathervane around the mooring buoy and continue pumping. The hard piping on the mooring base and the attached hoses provide the capabilities to pump two products simultaneously with its dual product swivel from the tanker to the beach. Within seven days, and with diver SLWT assistance, the SALM can be installed to provide uninterrupted, all weather product delivery. The SALM permits a tanker to remain on station and pump in much higher sea states than otherwise is possible in a spread moor. Figure 5-2, page 5-4, shows the 48-hour and seven-day OPDS configurations. Some characteristics of the SALM subsystem are listed below:

- SALM base dimensions are length, 150 feet long; beams, 57 feet; and depth, 12 feet.
- It has a dry weight of 839 short tons with all buoys, hose, and anchor chain on board.

• A series of hull and ballast tanks connected by internal and external piping allow flooding of the base under close control in water depths of 35 to 200 feet. Practical operational restrictions limit the depth to 190 feet for Navy support divers.

• Two mooring buoys; a shallow water (auxiliary) buoy; and a larger, deep water buoy are provided. The one used depends on the water depth. The main buoy weighs 55 short tons; the auxiliary buoy weighs about 6.5 tons. When the system is being recovered, a crane reloads both buoys on the SALM base.

• The mooring hawser with two sections of chafe chain attached is stowed in the tanker's focsle hold. The hawser is installed after the SALM is deployed.

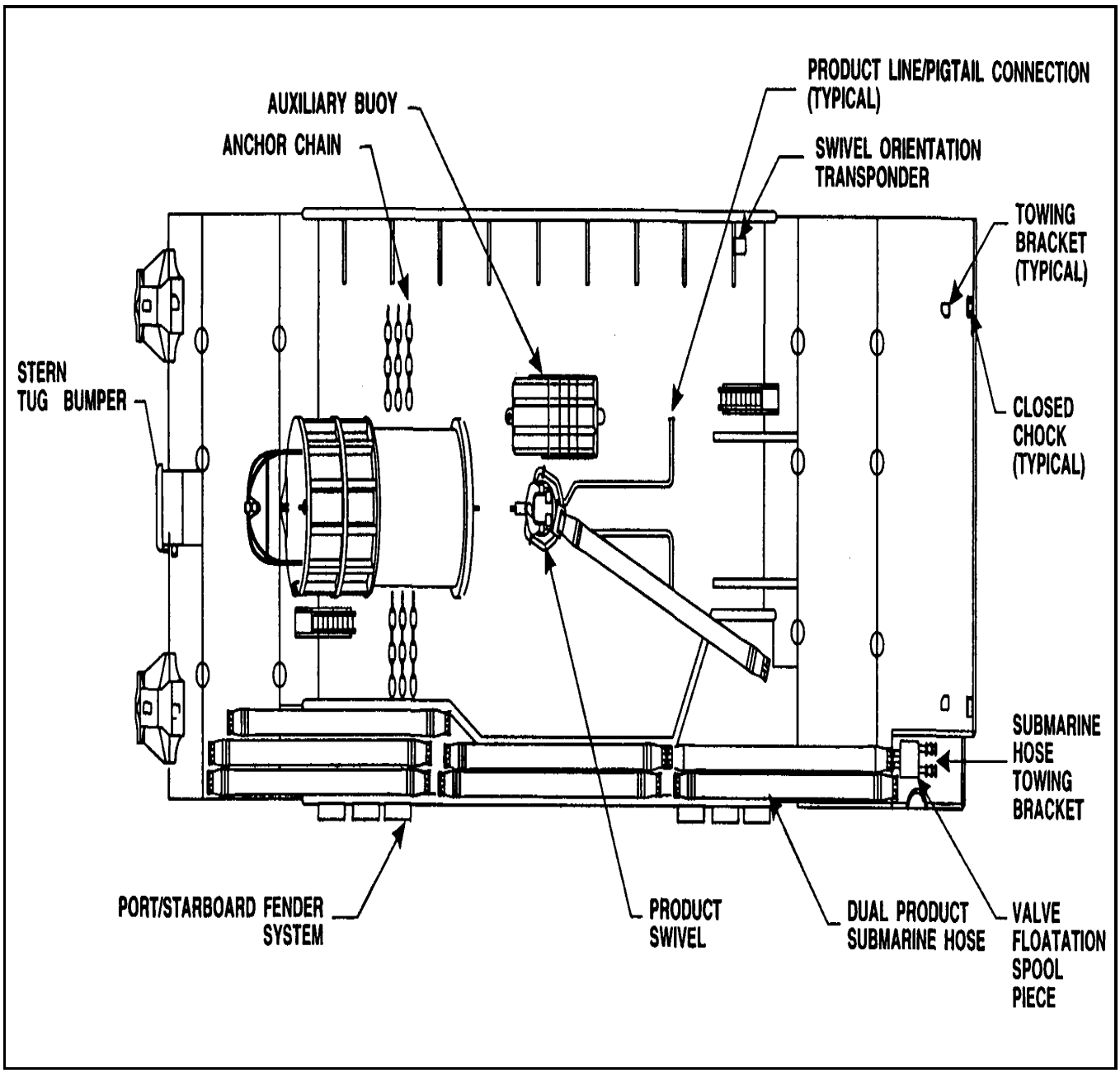

Figure 5-1. Single anchor leg mooring

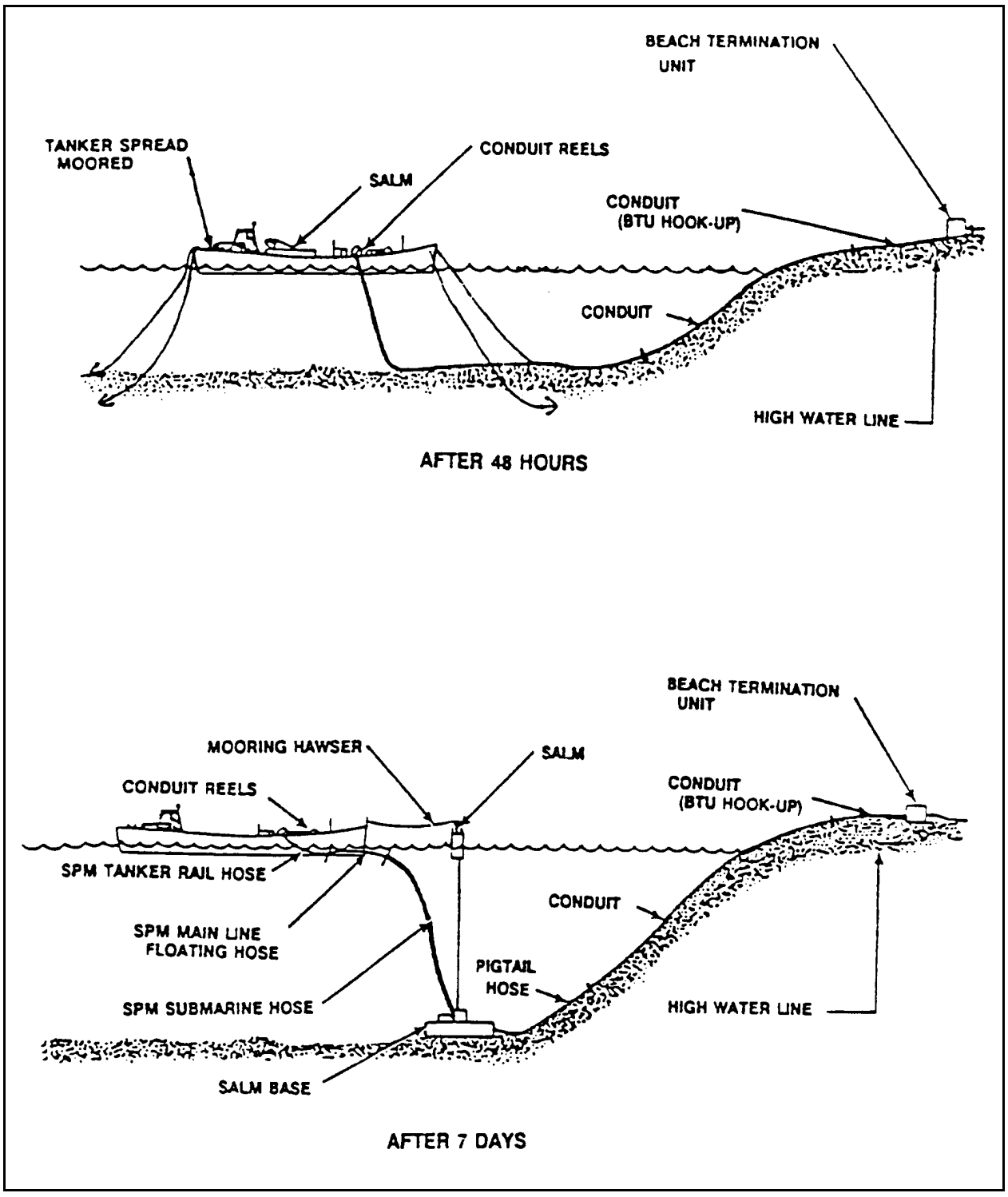

Figure 5-2. OPDS configurations

The SLWTs (Figure 5-3) are provided by other forces assigned to the amphibious operation. They provide OPDS with tanker carrier utility boats to make OPDS a stand-alone system. Four SLWTs are required for deployment of the OPDS. They must be modified for OPDS use with equipment and tools carried on the OPDS tanker. Three SLWTs are modified to act as tow tugs and the fourth unit is modified to act as the LRB. As soon as the tanker arrives, the equipment stored in its hold is offloaded onto the SLWTs and taken to a support area where the equipment can be installed by the Navy Amphibious Construction Battalion PHIBCB support personnel. Welding and removal of designated tie plates on each of the craft is required.

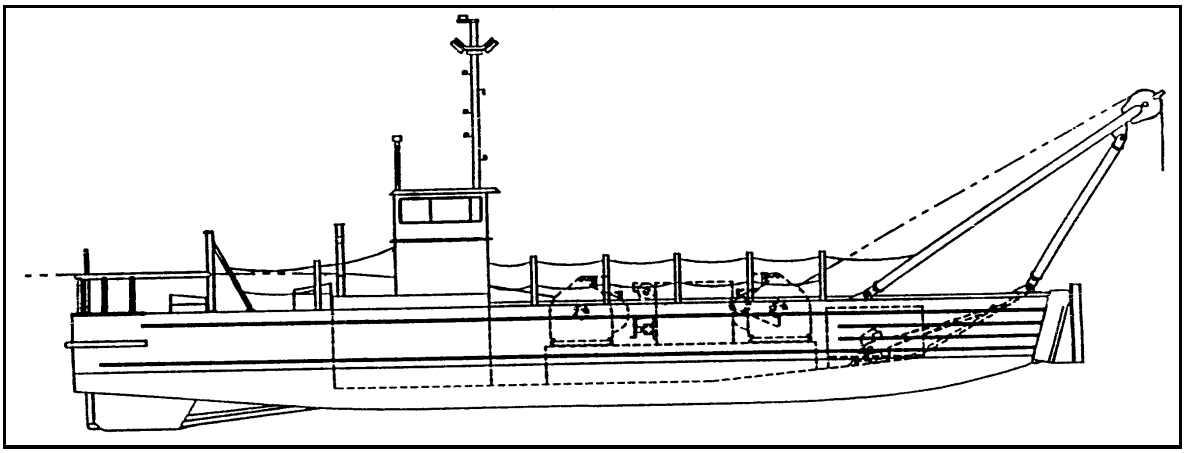

Figure 5-3. Side loadable warping tug

BEACH TERMINATION UNITS AND EQUIPMENT SET

Two BTUs are carried aboard the OPDS tanker to the deployment site. Depending on the requirement, one or both BTUs may be installed. The BTU has many functions for the OPDS **(Figure** 5-4,* see glossary); it is the high water mark termination of the OPDS. It is the anchor for the shoreward end of the conduit. It controls the pressure and fuel flow distribution through the hoseline from the SALM. It acts as an interface between the hoseline and IPDS. The following is a description of the BTU.

- The BTU steel casing measures 9 feet, 10 inches long; by 4 feet, 9 inches high; and 6 feet high. It weighs 8,700 pounds which includes the 1500-pound anchor, 100-foot. wire pendant valves and jewelry normally stowed on top or inside.
- Internal piping includes stop valves, a pig receiver, and pressure flow control valve.
- Gages show inlet pressure, outlet pressure, and pressure in the pig receiver. A product sampling port is in the recess with the pressure gages.
- Three large, gasketed covers bolted to the top of the BTU enclosure provide access to internals and valves. When the covers are in place, the BTU will float upright and can be towed ashore through surf.
- Roll bars on top of the casing can be used as lift points. Slots at the ends of the bottom frame are for attaching the anchor pendant, pendants to the restraining collar, or for a tow line.

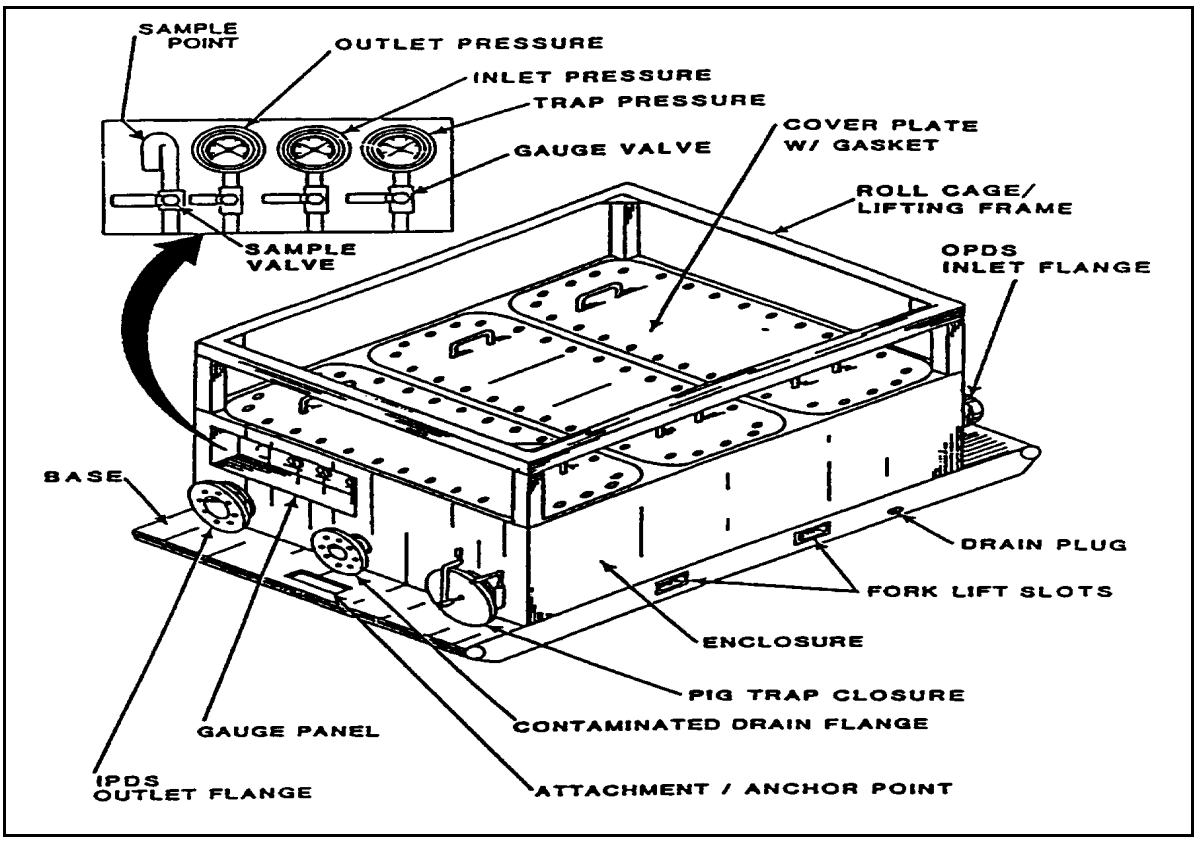

Figure 5-4. Beach termination unit

BTU Equipment Set

A BTU equipment set consists of two BTUs and component items. The OPDS beach termination equipment consists of the following:

- Two BTUs.
- Two 1500-pound Danforth anchors.
- Two 40-foot sections of BTU hook-up hose.
- Two sets of 100-foot pendants and fairleads.
- Two sets of special valve operating wrenches.
- Two conduit restraining bridles and pendant

CONDUIT AND COUPLINGS

There are two types of sea floor conduit manufactured for the OPDS; each has a 6 inch inside diameter and about an 8-inch outside diameter. They have different handling characteristics and end fittings. Special fittings are provided to connect one type with the other. Most OPDS conduit is flexible, steel-reinforced elastomer hose. It is designed in a float-sink configuration. When filled with air, the conduit has a positive buoyancy of about 1.9 pounds per foot. When filled with water or petroleum products, it sinks to the sea floor. On the seafloor, it has a negative buoyancy of about 8 pounds per foot. The conduit couplings consist of male and female fittings. The couplings are bolted together with six cap screws. The male fitting has a swivel flange that ensures ease of alignment with the female coupling. Each of the different hoses is listed below.

Dual Product Submarine Hoseline

The submarine hose conduit system (Figure 5-5) supplied aboard the mooring base tanker consists of eight hose assemblies and one hose support buoy assembly. Each hose section consists of two independent flow paths of 6-inch. inside diameters (Table 5-3, page 5-13.) encased by a semirigid carcass of 28-inch outside diameter with an air-filled annulus. The submarine hose provides a flow path to the product swivel on the base of the SALM from the floating hose string on the surface. The eight hose sections are sufficient for water depths up to 200 feet at the SALM site. The rigidity of the submarine hose string makes it function like a lever arm. It is enough to rotate the product swivel as tanker weathervanes around the SALM. The hoses (Figure 5-6, page 5-8) are marked with a white band running their entire length and are to be identified as types, AP, A, B, and C.

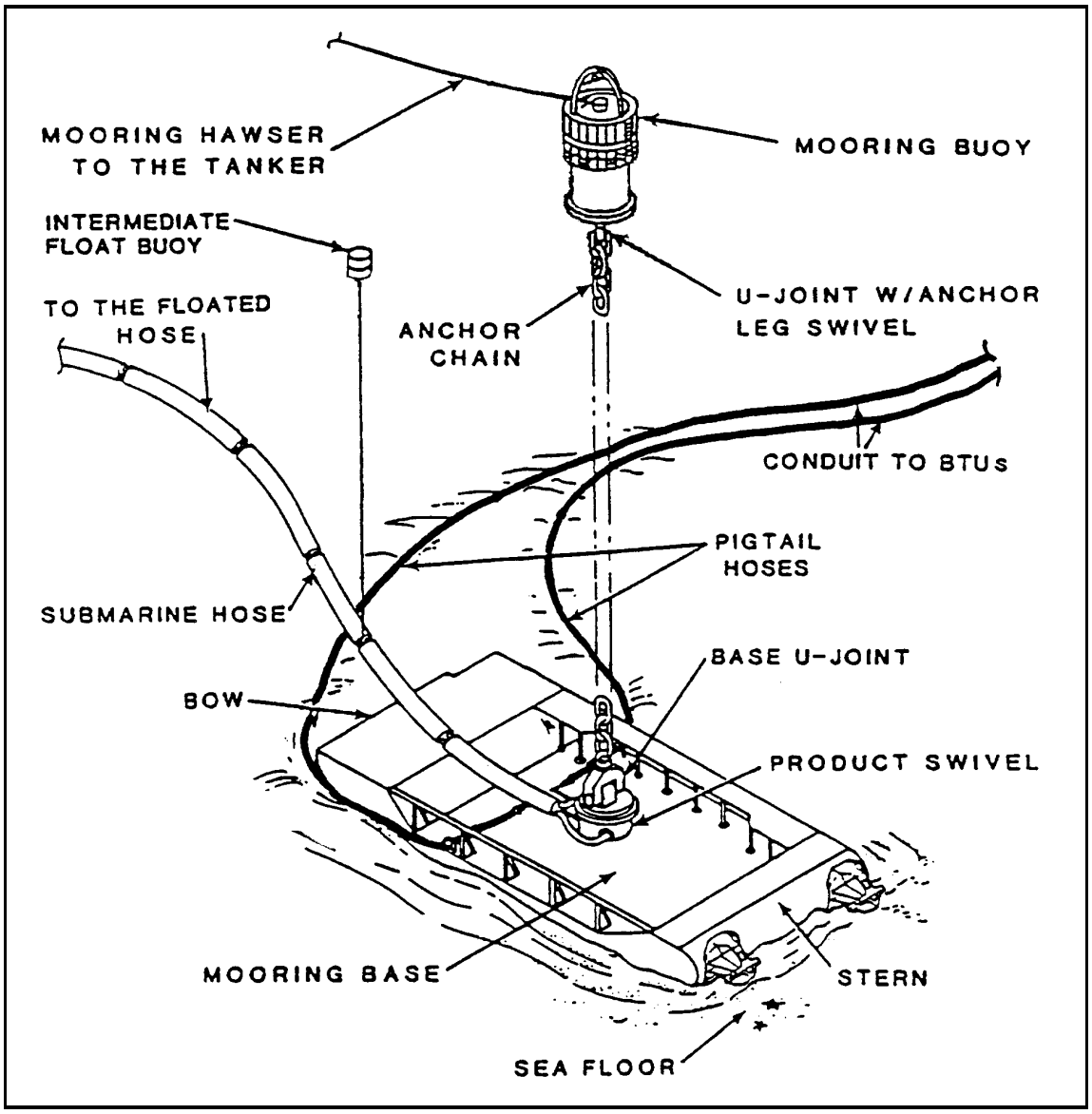

Figure 5-5. Dual product submarine hoseline

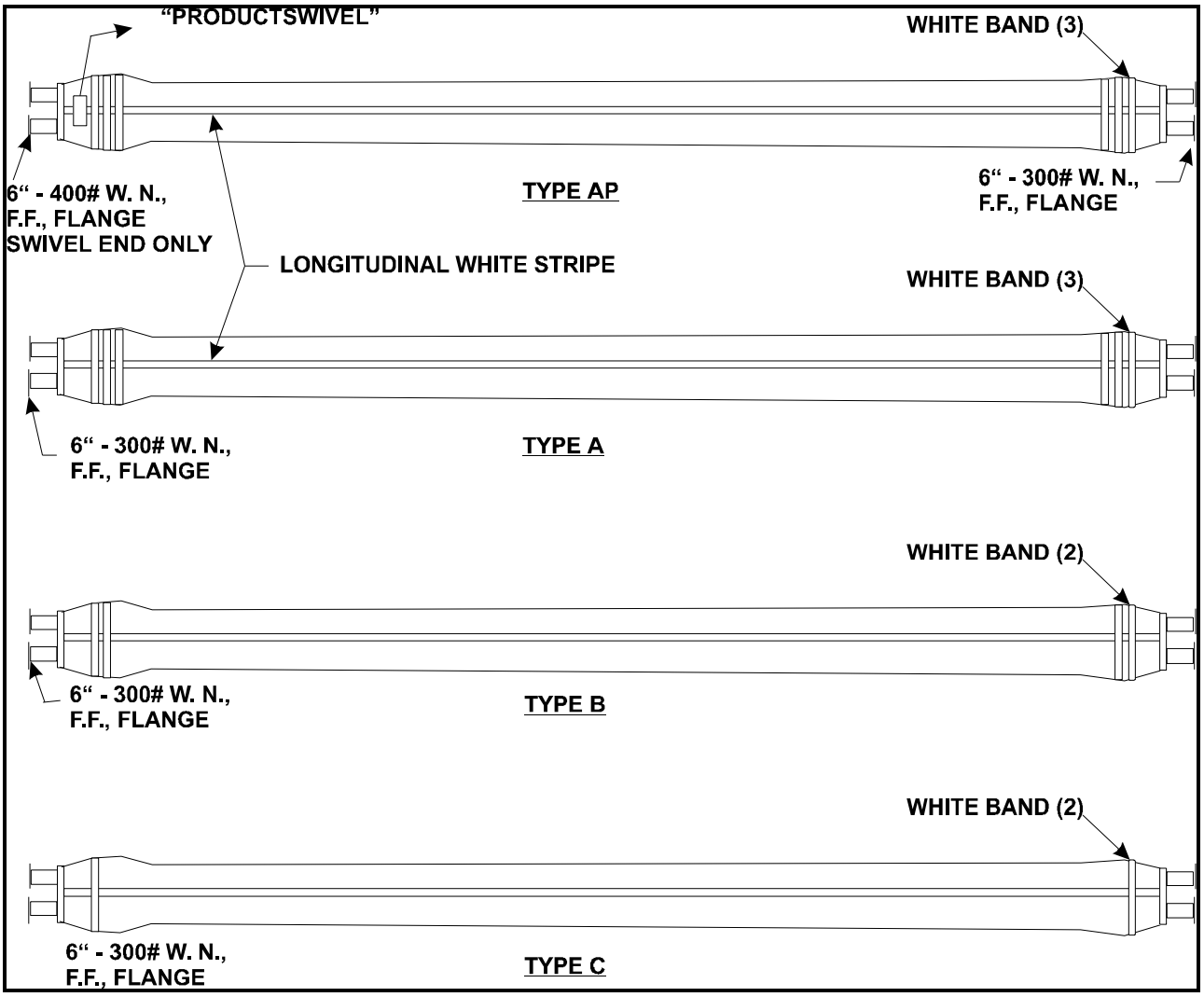

Figure 5-6. Submarine hoses

- Type AP and Type A are marked with three circumferential white bands at each end.
- Type B is marked with two circumferential white bands at each end is the water. It is the depth make-up hoses.
- Type C is marked with one circumferential white band at each end is the surface. It is surface support hose that interfaces to the floating hoses.

PigTail Hoses or Jumper Hoses

The two SALM pigtail hoses transfer the tanker's petroleum products from the mooring base to the flexible conduit. Each of the two SALM (Figure 5-7, page 5-9**)** pigtail hoses is 320 feet long and similar to the conduit in construction. It can be connected to the floating conduit end on the sea's surface by the SLWT crew after the SALM base is on the seafloor. Both pigtail hoses are capped with a blank towing flange to keep the hoses afloat during deployment. The hoses are stored on all the tanker's tenth reel except the S.S. Potomac.

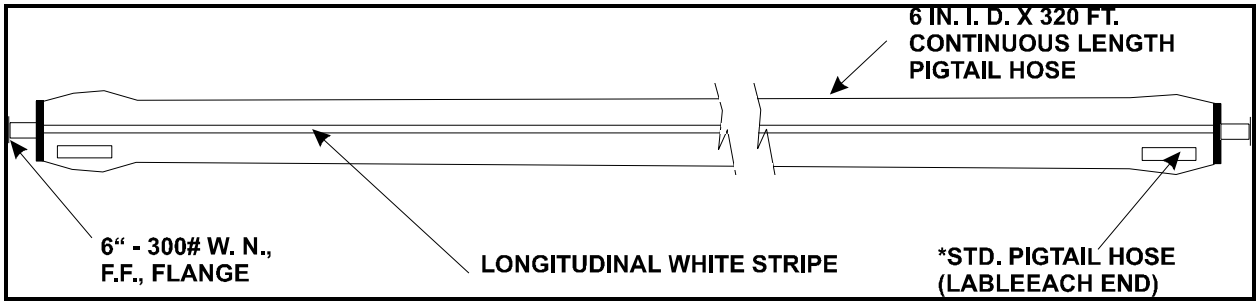

Figure 5-7. Pig tail hoses

Floating Hoses

The floating hoses transfer the product from the tanker’s manifold to the submarine hoses. This hose system is comprised of mainline floating hoses and tanker rail hoses. The mainline floating hose system consists of two 6-inch inside diameter hose assemblies, each 560 feet. long. Each assembly contains 14-hose sections of 40 feet lengths (floating mainline hose sections and 1 tanker rail hose section). The floating mainline hose are electrically continuous and the tanker rail hoses are electrically discontinuous. All floating hoses are marked by two longitudinal white stripes spaced 180 degrees apart along their entire length (Figure 5-8).

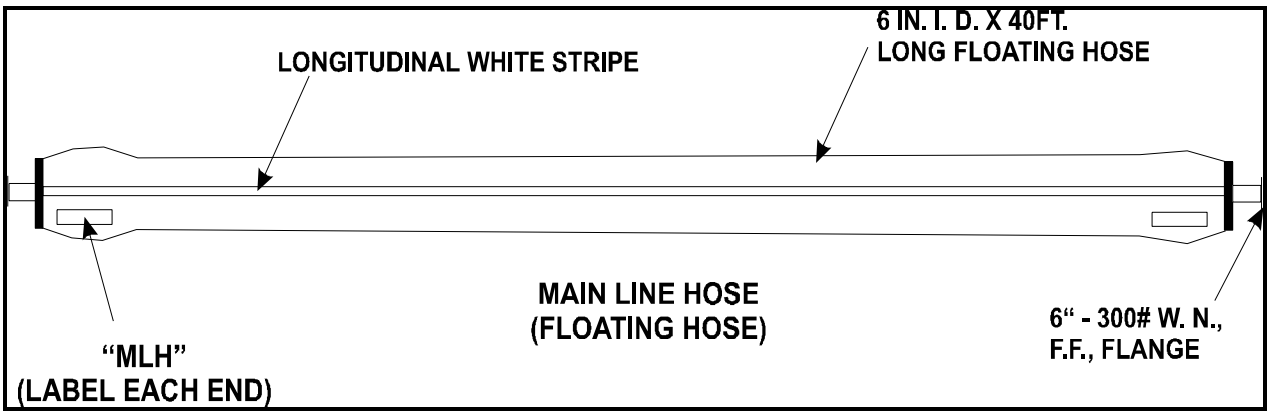

Figure 5-8. Floating hoses

Flexible Conduit Pipeline

There are 4 nautical miles of 6-inch hoseline included with the OPDS. The system uses high-pressure hoses on ship-mounted reels. Each reel holds 0.5 mile of collapsible hoses; eight reels make up the 4-mile kit. The hoses, which are not subject to corroding are made out of a smooth high-grade fuel-resistant synthetic-type rubber. They can be damaged and should be routinely inspected. The hoses can be stretched to 33 percent under normal conditions of use. Hose-to-hose and hose-to-fitting connections are made with 6- and 12-bolt flange connections that are designed for a burst pressure of 2,200 PSI. The 6-inch diameter and 1-inch thick hose has a maximum operating pressure of 740 PSI. The hoses weighs about 19 ½ pounds per foot. The U.S. Coast Guard hydrostatic pressure test is 1,014 feet per section with 24,336 feet per shipset. Petroleum is pumped using two positive displacement pumps in parallel (500 GPM each at 700 PSI). High pressure is required by the high head losses that result from delivery of 1,000 GPM in the 6-inch hose over the 4-mile (maximum) distance to shore.

Section III. BTU Procedures

DEPLOYMENT

The BTU is deployed from the OPDS tanker. The following procedures are used for deployment:

- Offload all equipment for the site from the tanker to a designated SLWT for transportation to the beach.
- Where possible, offload equipment directly to shore. If this is not possible, the BTU can be offloaded and towed ashore by a LARC-V. The anchor, if stored on top of BTU, should be removed and conveyed ashore separately.
- Move the BTU and equipment to the BTU site using forklifts or other vehicle.

BTU SITES

The site of the BTU for each beach terminus of the OPDS must be determined early in planning. The location should be suitable for connecting to the IPDS. Below is a list of the preparation rules to follow:

- Be above the high water mark.
- Be accessible by road or rough terrain vehicles.
- Have enough soil that permits burying the anchor or establishing a deadman capable of holding 30,000 pounds of tension.
- Establish the point from which the tanker/SALM position can be no more than 24,000 feet in the case of a single conduit line, but not more than 2 nautical miles distant for two conduit lines.

BEACH PREPARATION

Preparing the beach area for receiving the OPDS conduit requires equipment and personnel to set up the BTU site(s), range markers, lighting, and other items to support the installation of BTUs. Bulldozers help in bringing the conduit ashore and connecting it to the BTU hookup hose. Specific actions for each of the areas of support are given below.

Installing Beach Terminal Unit Bermed Area With Spill Catchment

Before performing any POL operation, consult the local environmental coordinator to check for the possible existence of special permit requirements. The BTU will be installed in a bermed site with a berm liner (Figure 5-9, page 5-11) to contain any fuel or contaminated water spills from the pig catcher. The berm area should be not less than 10 by 16 feet to permit personnel to move around inside the enclosure while operating/maintaining the BTU. If the berm floor is sloped, the high side should be seaward. Prepare an 8- by 8- by 3-foot hole 100 feet inland from the BTU site for the BTU anchor. Clear the area between the BTU and the sea to help connect the 40-foot hook-up hose and 6-inch ball valve to the BTU.

Installing Range Markers/Lights

Install range markers inland from the BTU site if room permits. Markers must be large enough and high enough for SLWT pilot to see the markers a minimum of 1 mile away. They must be at least 100 feet apart.

Setting up the Maintenance/Support Pier

If no harbor or other pier space is available, set up an administrative pier within a mile of the BTU/conduit site for the OPDS service craft. The pier should be at least 500 yards from the BTU so that it does not interfere with the SLWTs bringing the conduit to the beach.

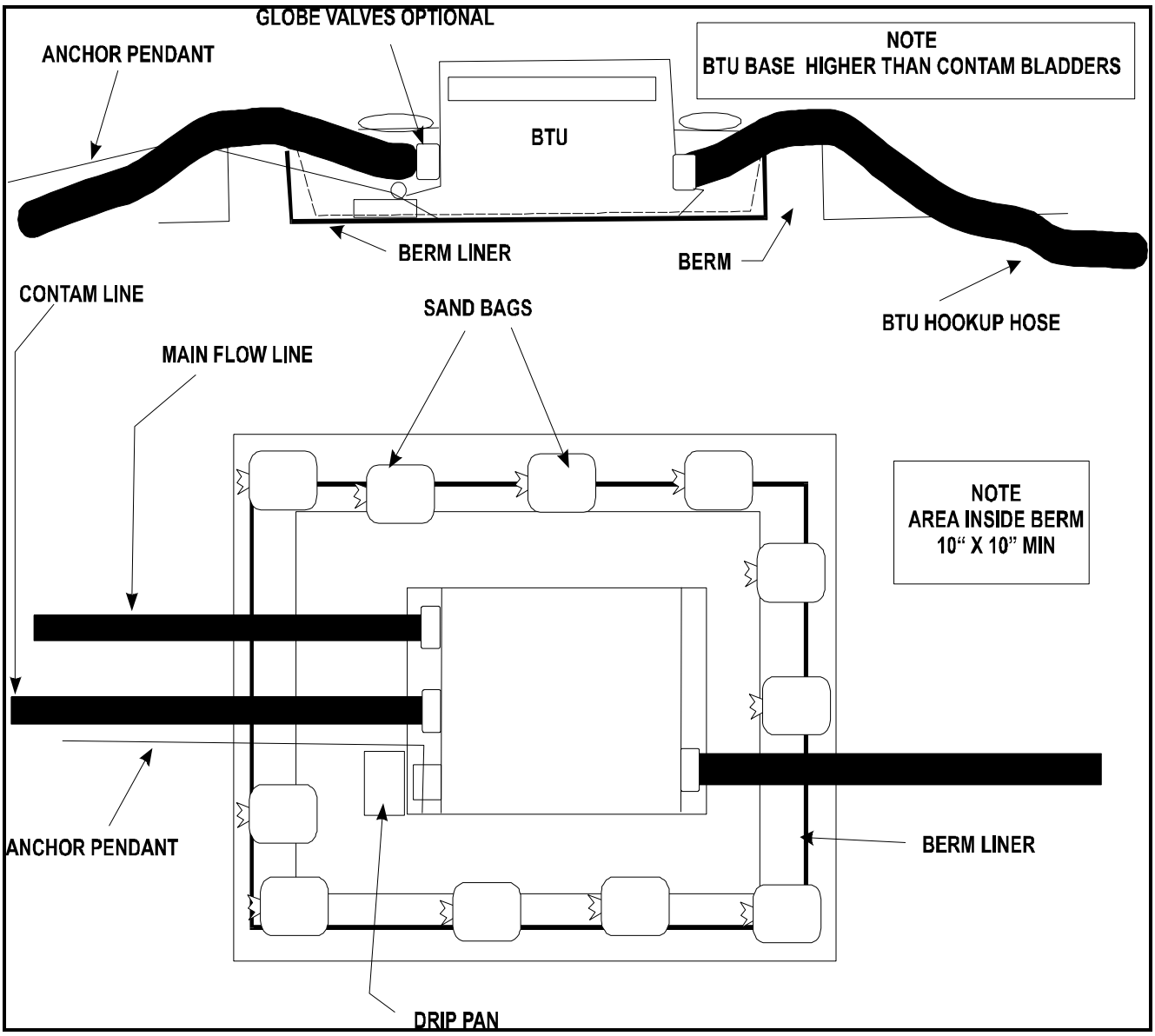

Figure 5-9. BTU with berm liner

Anchoring the BTU

Dig a hole for the 1,500-pound lightweight BTU anchor which is buried about 100 feet inland of the BTU. Dimensions of the hole are about 8 by 8 by 3 feet. Lower the anchor in the hole with the shank toward the BTU. Bury the anchor, covering it up to the jew's harp. Attach the 100-foot wire to the jew's harp and to the inland end of the BTU.

BTU OPERATIONS

After the BTU is installed and tested by the Navy personnel and flowing fuel, the remaining operations consist of monitoring the flow, correct operation of the flow control valve, and routine maintenance of the BTU. The BTU operators must maintain continuous communications with the tanker and with the onshore unit. Radio checks will be conducted regularly by net control. Any failure of radio communications is cause for immediate shutdown by the tanker. Operations at the BTU continue until fuel requirements are met. There will be interruptions in pumping during refueling of the tanker and when the SALM is being connected to the conduit string. All other procedures of the BTU are listed below.

Controlling the BTU

The BTU is operated by a Navy crewman for the benefit of the Army or Marine Corps onshore. The BTU crewman takes their orders from the onshore command unless other arrangements are worked out and reflected in the OPORD. The BTU crewman is trained to operate the BTU valves to perform certain functions during pigging, flowing product, and hydro testing the lines. The Army and Marine Corps should be sufficiently familiar with the operation of the BTU so they can check valve alignment for the ordered function. Depending on the downstream arrangement of hoses, valves, and bladders, a misaligned valve in the BTU could divert the wrong fluid into a storage bag and contaminate the bag.

Disconnecting The BTU

The method used for conduit retrieval determines when the BTU hookup hose is disconnected from the conduit. Onshore fuel connections BIU will be disconnected first and cleared from the immediate area. Uncover the hook up hose and conduit down to the surf area before disconnecting them. When ready to disconnect the BTU hookup hose from the conduit, secure the restraining collar and bridle to the seafloor conduit end fitting. Shackle a bulldozer's winch wire to a pelican hook to the bridle and take a strain on the winch wire. The pelican hook provides a positive control for release of the conduit. The hose and conduit are then unbolted and a female pulling cap attached to the male end of the conduit.

Flushing The BTU

Before the BTU can be returned to the tanker, it must be flushed, drained, and dried. The Navy PHIBCB or Army personnel need a freshwater supply air pump for this procedure. Use a forklift or crane to tilt the BTU casing once the flushing is completed. Unbolt the BTU hook up hose from the inlet valve flange and prepare for retrieval to tanker.

Retrieving The BTU

The BTU is prepared for recovery by PHIBCB or Army personnel. A designated tow rigged SLWT proceeds to the BTU site. If a pier is available, forces ashore transport the BTU there and load it onto the SLWT. They also load the anchor, pendants, hook-up hose, and other fittings. In the absence of a pier, the BTU, anchor, pendants, and fittings are moved to the shoreline. The SLWT passes its forward winch wire to the beach by small craft. The anchor, fittings, and pendant are then pulled out and lifted on deck with the A-frame. At the tanker, the forward boom of the tanker lifts the BTU and all its equipment from the SLWT to the forward deck.

Table 5-3. Conduit and hose characteristics

Items		Bore Size (inch)	Outside Diameter Normal (inch) Body/Ends	Maximum Allowable Working Pressure (psig)	Burst Pressure (psig)	Electrical Continuity
Conduit		6.00	7.85/8.85	714	2220	No Requirement
Tanker Rail Hose		6.00	10.0/17.5	714	2220	Discontinuous
Floating Hose		6.00	12.0/13.0	714	2220	Continuous
Submarine Hose	A	6.00	28.0/30.0	714	2220	Continuous
	B	6.00	27.7/29.7	714	2220	Continuous
	C	6.00	26.7/29.5	714	2220	Continuous
Pigtail Hose		6.00	7.85/8.85	714	2220	No Requirement
BTU Hook-up Hose		6.00	7.85/8.85	714	2220	Discontinuous

Section IV. Planning and Administrative Considerations

OPDS DEPLOYMENT CONSIDERATIONS

When the OPDS tanker arrives, the JLOTS commander holds an OPDS deployment conference on board the tanker. The meeting is to coordinate efforts of the OIC OPDS and all participating OPDS deployment elements. Attendees review the OPDS deployment plan. They refine it for the existing scenario and work out last-minute details. The meeting considers all facets of OPDS installation to include:

- Site Surveys. The survey must include maximum steepness of bottom gradient for SALM, 1:25 with good hoding potential and nonrocky bottom; within 4 nautical miles of beach termination site (2 miles for two products); and known depths.
- Swing Circle for the OPDS Tanker Around the SALM. The swing circle must allow ½ -mile diameter with no bottom hazards and minimum boat traffic in area (except to ship or for security).
- Conduit Route. The route must be free of rocky escarpment or other bottom hazards that would cause damage to the conduit and clear of boat traffic.
- Communications Plan. The plan must include communication networks, procedures, equipment, control stations and security requirements as needed.

PRODUCT DISCHARGE CONFERENCE

Before the initial pumping of product, the JLOTS commander will hold a PDC. This PDC will ensure safe pumping operations and mutual (ship and shore) understanding of procedures. A review and initialing of the OPDS POL communications checklist will also be done. The checklist must be signed whether the deployment is exercise or wartime. The meeting includes the Army Petroleum Operations Officer, the ship's master, and pumping master. Fuel quality, quantity, and product delivery schedule will be agreed upon before any product discharge. The OPDS deployment conference may be combined with the PDC. Also with the PDC, the Army or Marine Corps quality control specialists will inspect the ship's product tanks and take fuel samples. They will test product samples IAW MIL-HDBK-200 to ensure the products to be pumped ashore meet specifications.

ENVIRONMENTAL CONSIDERATIONS

The JLOTS commander is responsible for monitoring and keeping the OPDS OIC and ship's master informed of weather conditions. During deployment and recovery operations, the OPDS OIC will determine when to suspend operations due to weather. During pumping operations, the ship's master makes this determination and will notify the Army or Marine Corps of intent to discontinue operations.

Section V. Communications and Installation

COMMUNICATIONS EQUIPMENT

The OPDS-installed tanker transceivers include as a minimum one each HF, VHF, and SSB or UHF transmitters and receivers. These units are used for general communications, OPDS deployment/recovery, and for pumping operations. There are 20 portable hand-held 5-watt transceivers (30-75 MHZ) that are part of the TOE. The PHIBCB personnel on the tanker, support craft, and ashore will use those or similar radios in addition to standard military VHF radios. During deployment and recovery, the Army onshore will use PRC-77 or equivalent. The hand-held VHF radios have a range of about 4 miles at tanker deck level and an operating life of six to eight hours.

OPDS OPERATIONS REQUIREMENTS

During OPDS deployment and recovery, long-range and secure tactical voice communications are not usually required. Operational communications require sufficient range to reach from the IPDS onshore and the tanker,

which may be in excess of 20 miles. Also, for tactical reasons, secure voice communications may be required. The Army petroleum distribution commander ensures communications equipment is compatible with the OPDS tanker. If the communications equipment is not compatible for product scheduling or off-load operations, the Army unit onshore will provide the necessary equipment.

WARNING

Any person who notices an unsafe condition is authorized to radio to the tanker to stop pumping.

ONSHORE COMMUNICATION PLAN

Good communications are needed throughout all phases of OPDS planning, deployment, recovery and operation. Most OPDS installation and recovery operations are controlled by soldiers using VHF walkie-talkie, hand-held radios with at least six-channels. The onshore fuels distribution system delivers fuels from the BTU to locations ashore. It consists of one or more conduits, storage facilities, and pumping stations, as well as related monitoring and control systems.

- A general list of communications areas required for onshore fuels distribution operations is given below.
  - Ship-to-shore operation.
  - Fuels dispensing.
  - Conduit supply
  - Conduit pump station operation.
  - Conduit security. Dedicated frequencies must be allotted to support these functions.
- The tactical petroleum terminal dispatch center controls the overall system. The dispatch center acts as the fuel scheduling and transportation control center. It may be located up to 100 miles inland.

WARNING

The tanker will stop pumping whenever communications with the beach is list for one minute.

PUMPING COMMUNICATIONS AND CONTROL

There must be a dedicated communications pumping network and a backup network that are manned and operable every second so that the tanker can be advised to stop the pumps in an emergency. The tanker has pump shut down buttons in three locations, any one of which can be used to shut down the pumps under emergency conditions (loss of lubrication, possible pump damage). There is always a tankerman close to at least one of the buttons, usually to two buttons during pumping operations. However, they will not react until so directed by the beach. Any person along the flow path is authorized to give a stop pumping order to the tanker if he notices an unsafe condition. The tanker may shut down pumping operations because of equipment or other problems on board the ship, but will always advise the beach as soon as possible. The Army or Marine Corps must anticipate all problems.

OPERATIONAL PROCEDURES

The sequence of events for the OPDS deployment is as follows:

- OPDS site surveys by UCT or other underwater units.
- The tanker arrives and anchors.
- The arrival conference is held.

- Deploy tanker mooring area, SALM area, and conduit route marker buoys in surveyed areas.
- The first two of the SLWTs that are outfitted as two tugs are assigned to assist the tanker into the spread moor by kedging the two quarter anchors.
- The tanker maneuvers with the help of two tow tugs into it four-point mooring.
- All four SLWTs pull conduit off the tanker and deploy as much as 4 miles of flexible pipeline to the beach.
- Install BTUs, berm if necessary.
- Conduit is pressure-tested. When the tanker is within 2 miles of the BTU site, two flow lines can be laid. Remove kinks and twists. Connect each to a BTU.
- The Product Discharge Conference on the tanker is held.
- Within 48 hours of arrival, the tanker should be ready to pump petroleum products, as directed by the user command to the beach at a rate of 1.2 million gallons per 20-hour day.
- Within seven days, and with divers and SLWT assistance, the SALM can be installed to provide uninterrupted, all weather product delivery.